

# Ballast Dispersion Testing

**Presentation for:**  
**Environmental Soundness Meeting**  
**8 January 2004**


Presented by:  
Kevin J. Reynolds, PE  
The Glosten Associates, Inc.



# Today's Presentation

***Goal: Present Protocol Outline  
of Testing for Feedback***

## **Outline:**

- ◆ **Glosten, Ballast Systems, Overview**
  - ◆ Dispersion Variables
  - ◆ Testing Procedures
- 
- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, extending from the right edge towards the center.

# **The Glosten Associates™**

## ***Consulting Engineers Serving the Marine Community***

**Founded in 1958 - we have grown to a staff of 50 through:**

- ◆ Engineering Excellence and High Quality Service to Commercial Vessel Owners and Operators.
  - Naval Architecture and Marine Engineering
  - Ocean Engineering and Analysis
- ◆ Practical Application of Engineering & Analysis to Technical Problems

# Overview of Ships' Ballast Water



# Ballast Water is Essential to the Operation of Most Ships

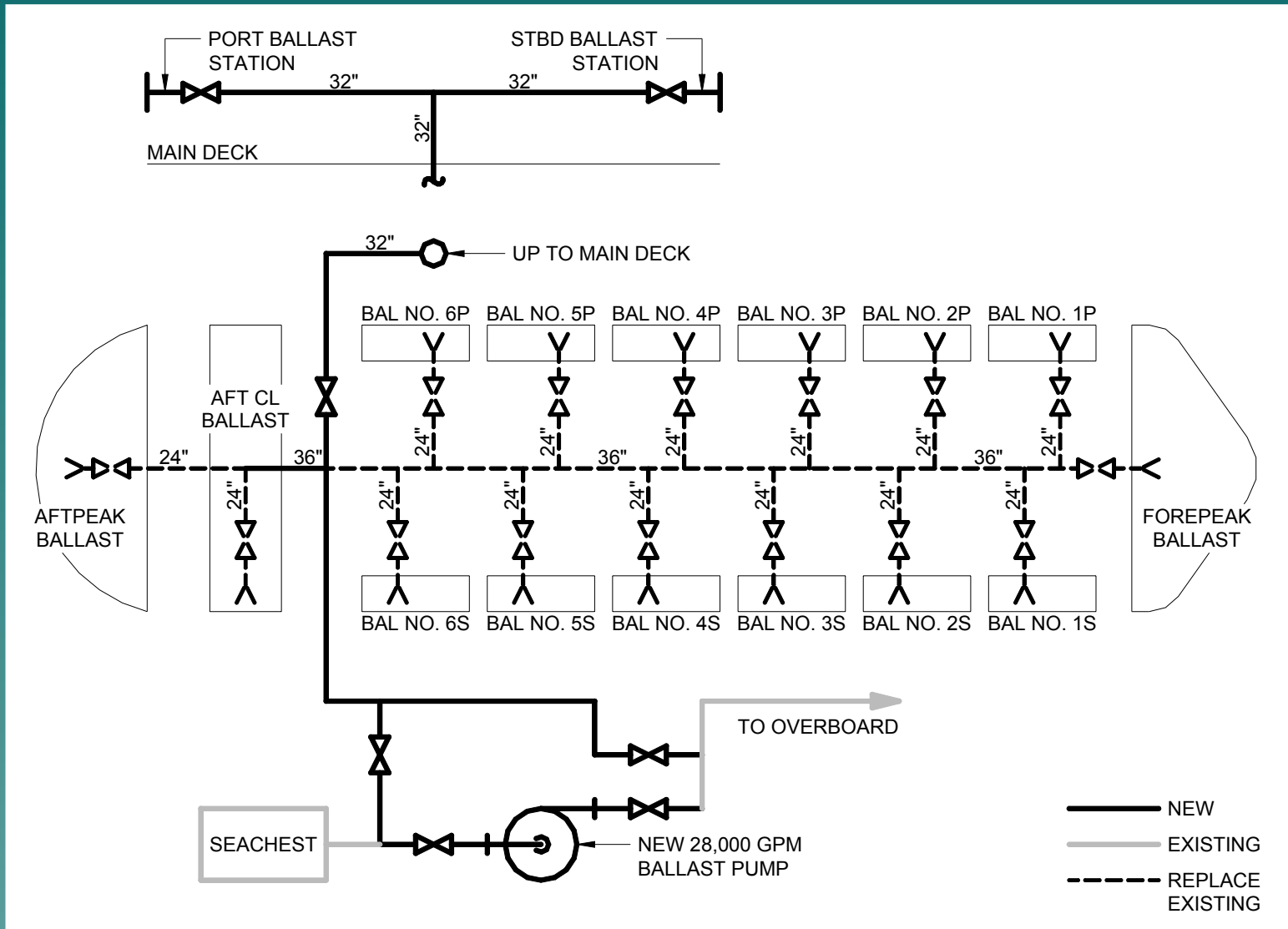
- ◆ After discharging cargo, ballast water is loaded
- ◆ At sea empty, in the return condition, ballast water is needed to:
  - Control Hull Structural Stresses
  - Control Stability – resistance against capsizing
  - Submerge Propeller
  - Reduce slamming of waves impacting the hull

# Crude Oil Carrier



Type: 125,000 Dwt Crude Oil Carrier in TAPS Trade  
Owner: Polar Tankers, Inc.  
L x B x D: 273m x 46m x 25.3m  
DWT: 127,005 MT  
Ballast Cap: 60,700 m<sup>3</sup>  
Ball. Pumps: 2 @ 2,860 m<sup>3</sup>/hr mains, 2@1,000 m<sup>3</sup>/hr aft  
No. Ball Tks: 6 pairs + 1 fo'c'sle + 4 aft tanks

# Ballast Systems are Complex





# Today's Presentation

***Goal: Present Protocol Outline  
of Testing for Feedback***

## **Outline:**

- ◆ Glosten, Ballast Systems, Overview
- ◆ Dispersion Variables
- ◆ Testing Procedures



# Ballast Dispersion Testing Goals

**Determine Dispersion of Ballast Water as it discharges into the sea**

***Specific Vessel, Specific Variables***

- ◆ Dispersion Ratio for tested vessel at “Worst Case Scenario”
- ◆ Dispersion Ratio Order of Magnitude (General)
- ◆ Baseline Variables to support further testing, modeling as needed.

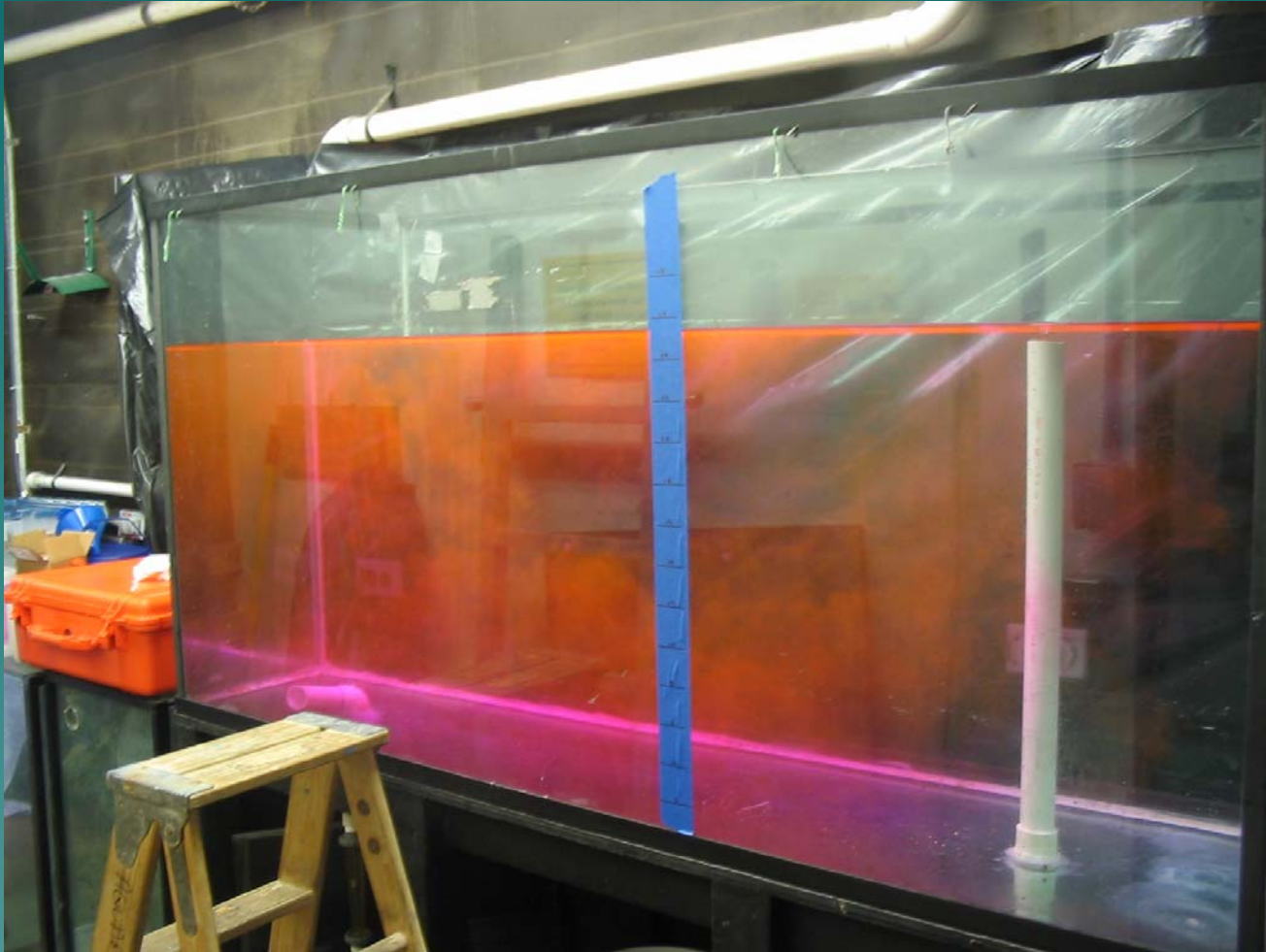


# Shipboard Trial



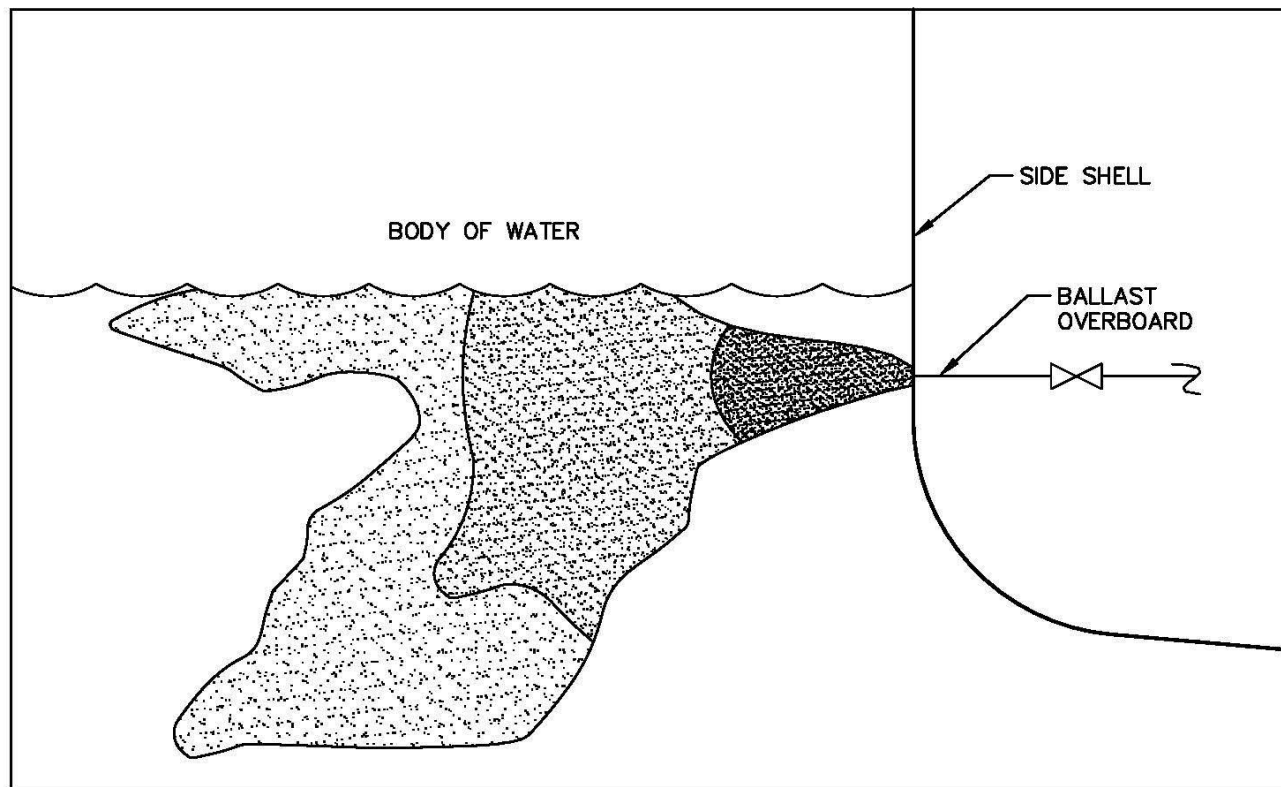
*S/T Tonsina, Flowthrough Exchange*

# Rhodamine WT Dye

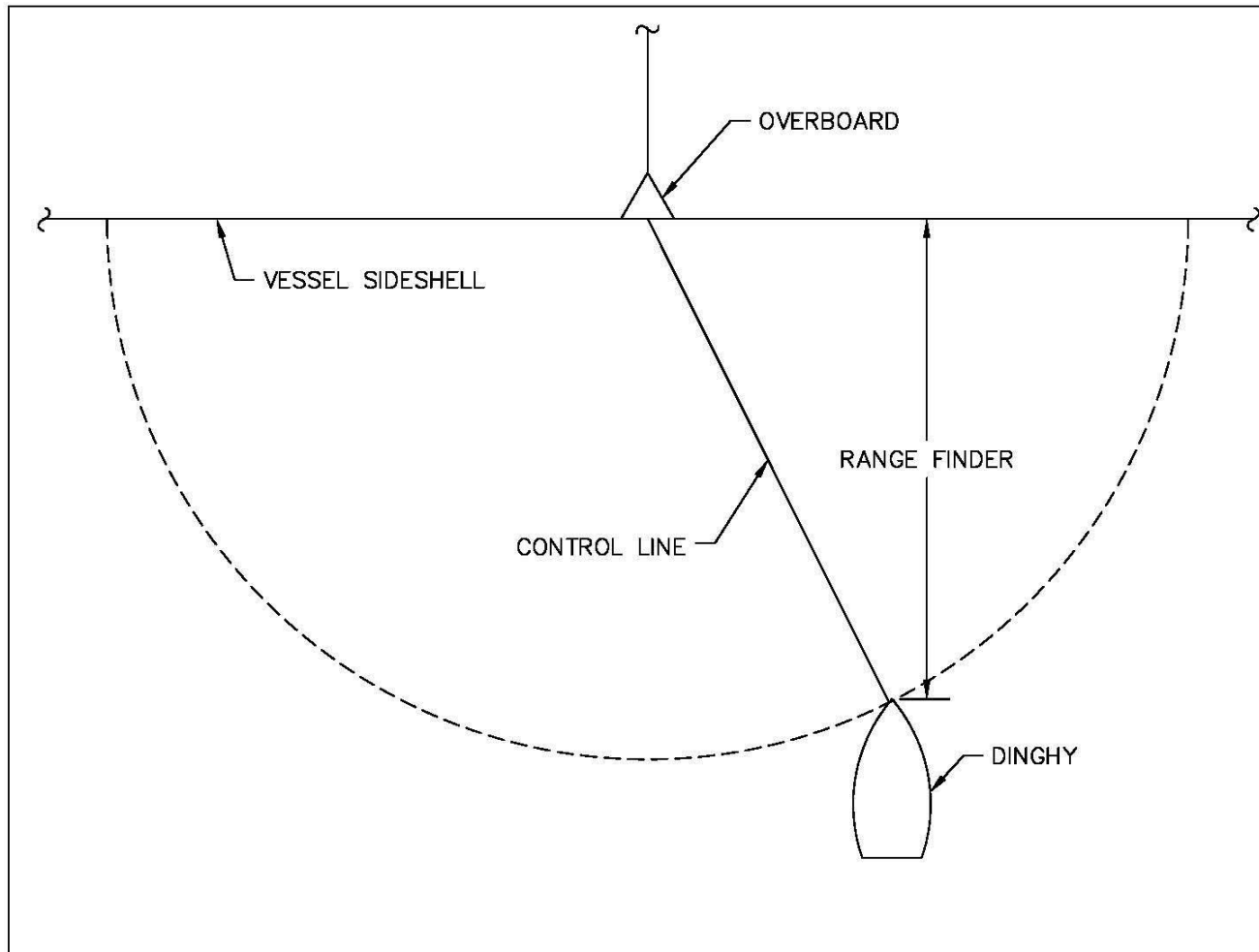


*Mixing Study Performed at Seattle Aquarium*

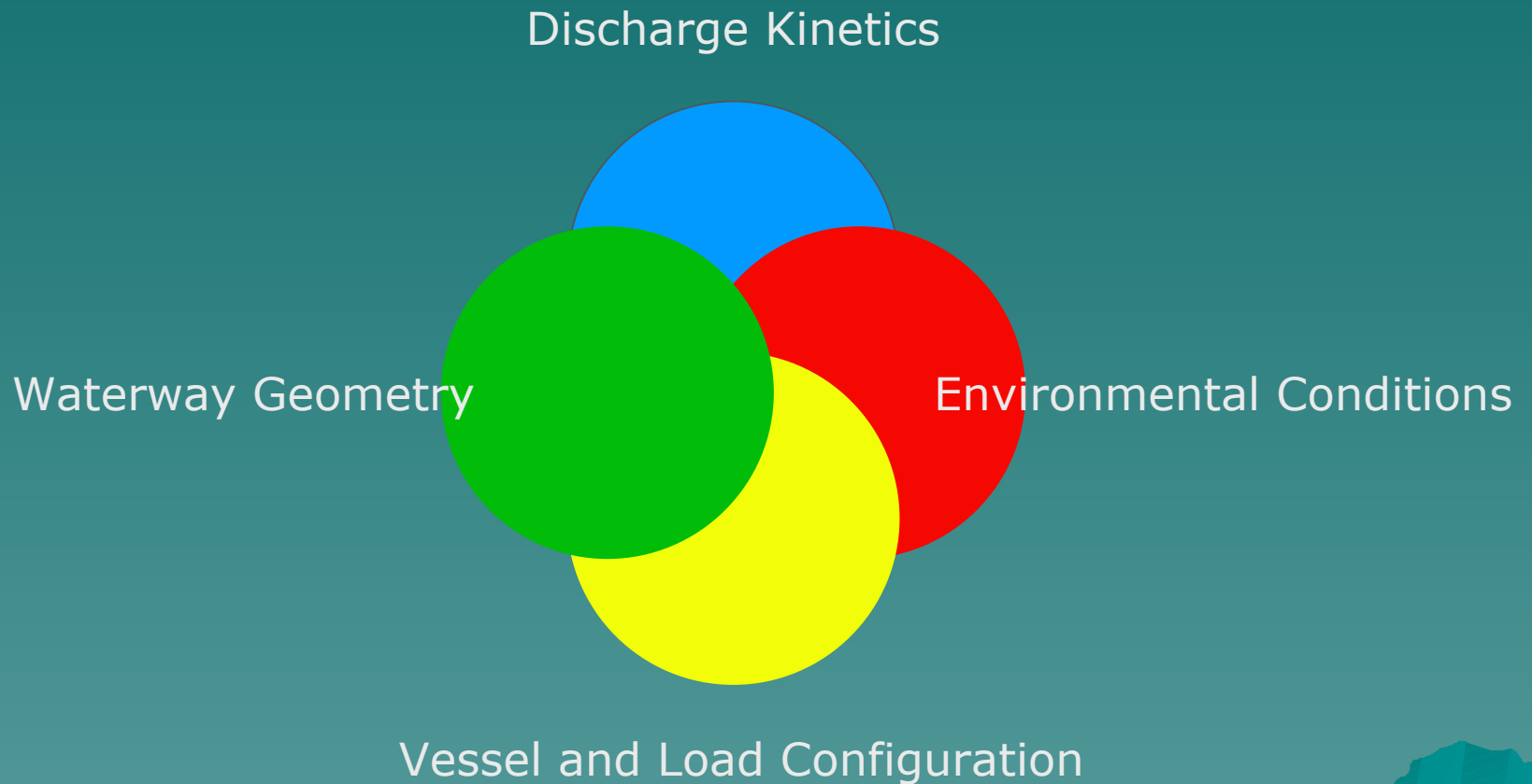
# Ballast Dispersion



# Sampling Method



# Dispersion Variables





# Dispersion Variables

## Discharge Kinetics

- ◆ Relative density of ballast to sea
  - Neutrally buoyant
- ◆ Volume flow rate
  - Typical for vessel
- ◆ Discharge velocity
  - Seachest flowrate



*Anchor in Prince William Sound*



# Dispersion Variables

## Environmental Conditions

- ◆ Current Speed and Direction
  - Slack Tide, less than 1 knot
- ◆ Wind/Wave Force, Direction
  - Calm Conditions
- ◆ Vessel Relative Heading
  - Support Dispersion Plume Measurement

# Dispersion Variables

## Vessel and Load Configuration

- ◆ Overboard Configuration/Orientation
  - Seachest at bilge turn
- ◆ Vessel Draft at Discharge
  - Submerged at 28 feet



*Prince William Sound Sunset*

# Dispersion Variables

## Waterway Geometry

- ◆ Depth and Width
  - Free movement of discharge plume
- ◆ Obstructions
  - Clear of docks, mooring, etc.
- ◆ Tidal Condition
  - Nearly static



*ITB New York, US Shipping*

# Today's Presentation

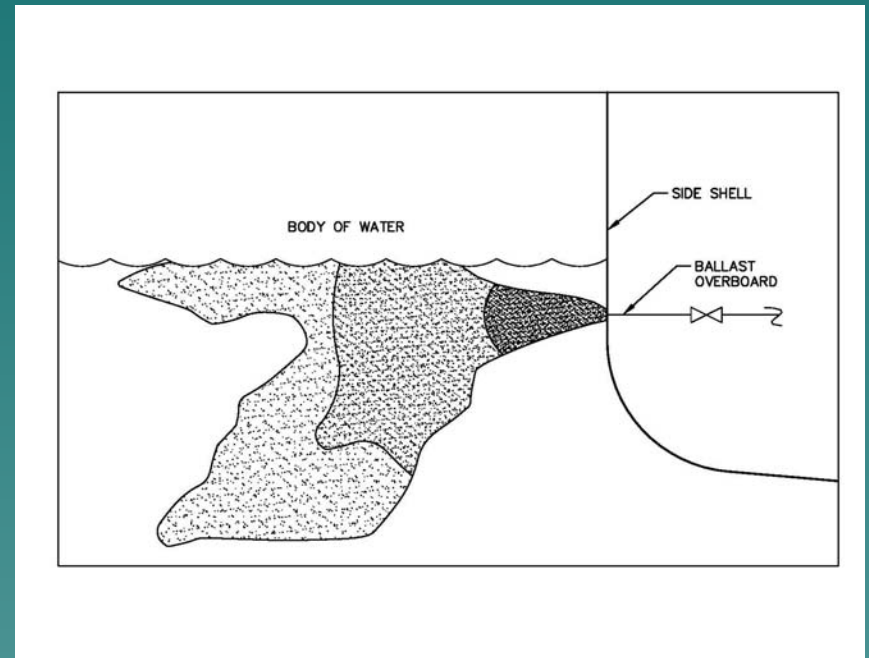
***Goal: Present Protocol Outline  
of Testing for Feedback***

## **Outline:**


- ◆ Glosten, Ballast Systems, Overview
- ◆ Dispersion Variables
- ◆ Testing Procedures

# Testing Procedures

- ◆ Testing Guidelines
- ◆ Hazard/Safety Considerations
- ◆ Rhodamine WT Dye
- ◆ Testing Instrumentation
- ◆ Process
  - Dye Injection
  - Environmental Data
  - Tank Concentration
  - Discharge Concentration



# Testing Procedures Guidelines

- ◆ USGS Fluorometric Procedures for Dye Tracing
  - ◆ Vessel Master
  - ◆ Previous Shipboard Dye Testing Work
  - ◆ Familiarity with Shipboard Systems
- 
- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, adding a decorative element to the background.

# Testing Procedures

## Hazard/Safety Considerations

- ◆ Vessel Crew and Testing Team Personal Safety
  - Communications
  - Safety Gear
  - Vessel Safety Rules Orientation
- ◆ Environmental Hazards
  - Standard Vessel Procedures
  - Rhodamine WT Dye (MSDS)
  - Pollution Criteria
    - ◆ Washington State Law, RC 90.48
    - ◆ United States Coast Guard
    - ◆ WA Department of Ecology
- ◆ Vessel Structure and Equipment Safety
  - Vessel Hull Stresses and Stability
  - Handling of Dye, Operation of Equipment





# Testing Procedures

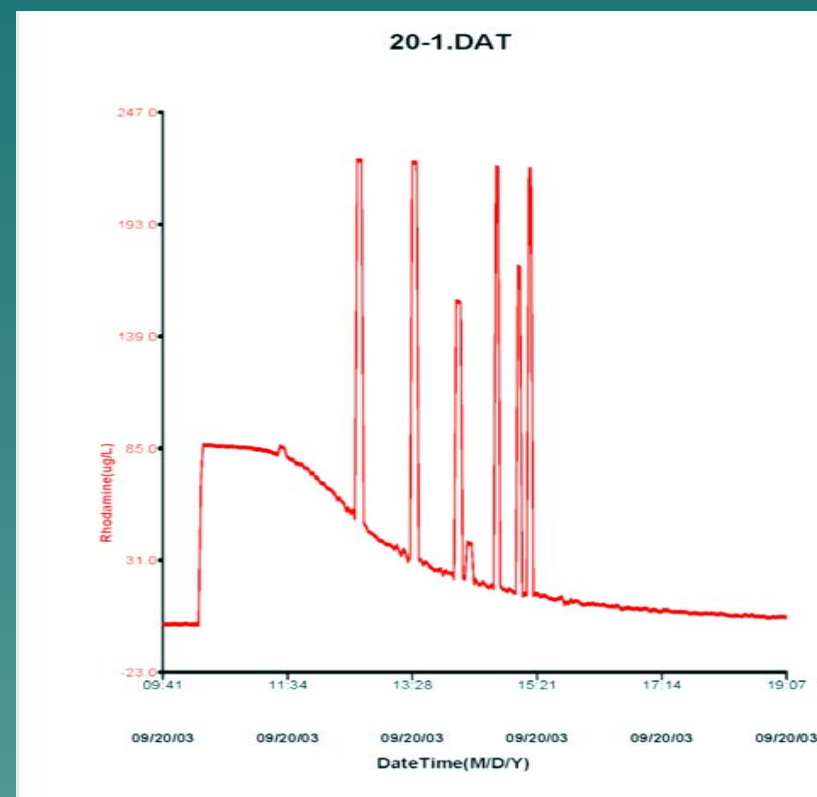
## Rhodamine WT Dye

- ◆ Material Data Safety Sheet
- ◆ Published Material
  - Intracid Rhodamine WT MSDS: This is the MSDS sheet for the actual dye used in the testing. The max concentration of dye to be discharged is 220 ug/L (parts per billion). The MSDS lists “no developmental abnormalities or toxicity to oyster larvae at 100 mg/L,” 455 time the maximum concentration for this dispersion testing.
  - Intracid Rhodamine WT Spec: This document details common uses including a statement: “Intracid Rhodamine WT Liquid is certified by the National Sanitation Foundation International (NSF International) for use under NSF Standard Number 60, Drinking Water Treatment Chemicals -Health Effects, to trace drinking water.”
  - Keystone 65 Spec and 89 Spec: The 65 Spec documents that up to 40 parts per million of rhodamine WT are typically used in tracer studies, 181 times the maximum concentration for this dispersion testing. The 89 Spec is more specific to rhodamine WT, and provides additional references regarding environmental hazards.

# Testing Procedures

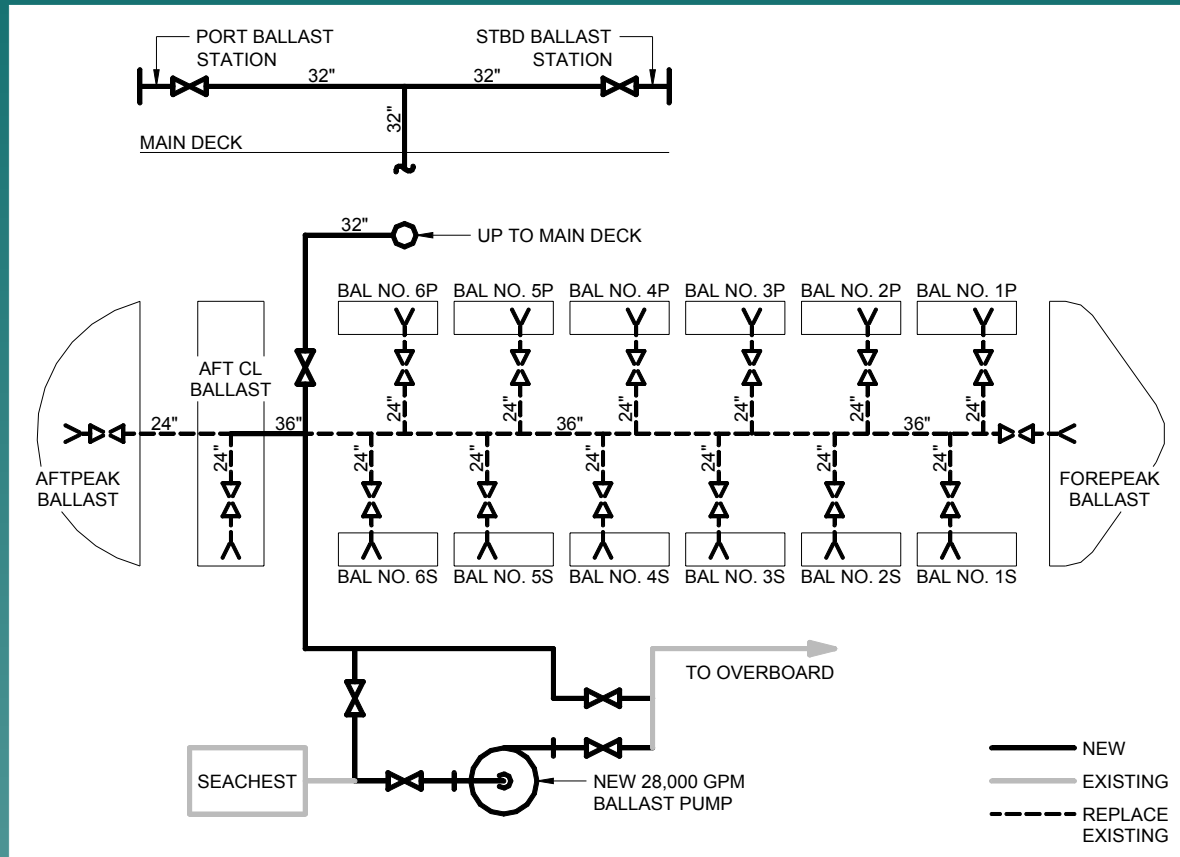
## Measurement

- ◆ Dye Concentration – Target 160 parts per billion
- ◆ Measurement with YSI model 650 MDS datalogger, with 600 OMS sonde
  - Range 0 to 200 ppb
  - Accuracy +/- 1 parts per billion (absolute terms)
  - Display to 0.01 parts per billion
  - Relative accuracy of dyed tank to dispersed measurements



# Testing Procedures

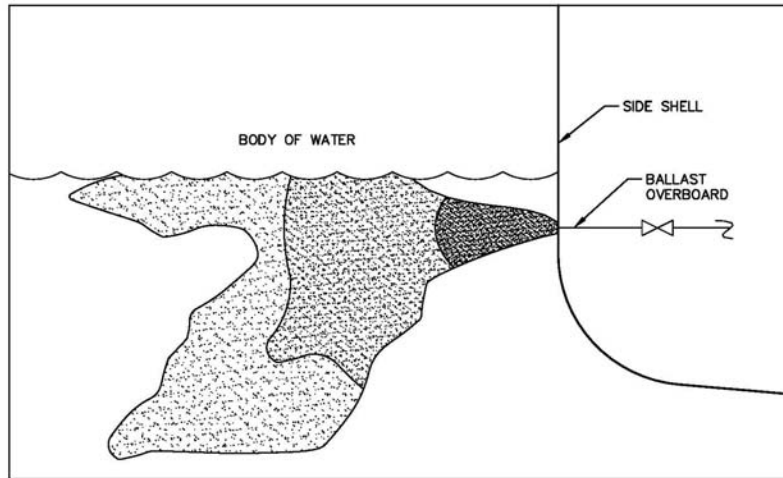
## Dye Injection



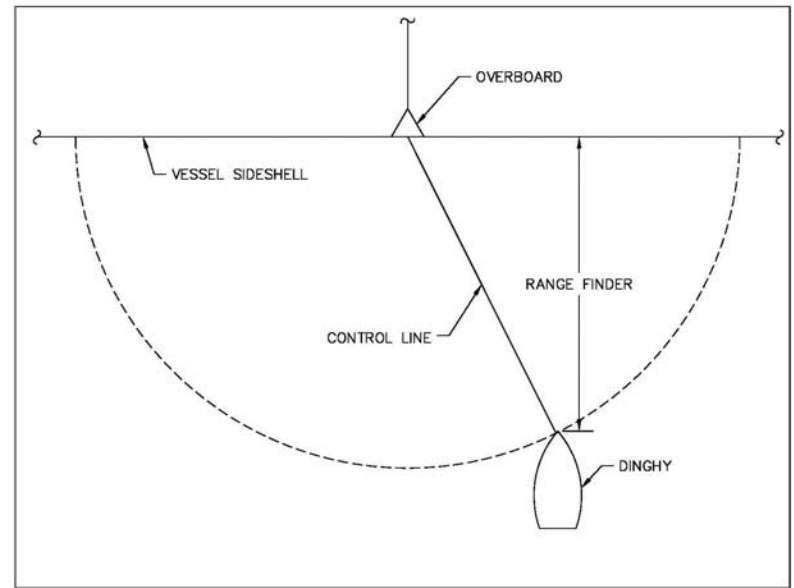
Metering-in Dye during Filling Process

# Testing Procedures

## Discharge Measurement



Dispersion Plume



Measurement  
Arc

# Thank You!

## Ballast Dispersion Testing

Presentation for:  
**Environmental Soundness Meeting**  
**8 January 2004**

Presented by:  
Kevin J. Reynolds, PE  
The Glosen Associates, Inc.

